NAVAL WAR COLLEGE
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OPERATIONAL METEOROLOGY AND OCEANOGRAPHY AND NETWORK-CENTRIC WARFARE: IMPLICATIONS FOR THE JOINT FORCE COMMANDER

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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13 February 1998

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Security Classification This Page

REPORT DOCUMENTATION PAGE

1. Report Security Classification: UNCLASSIFIED	
2. Security Classification Authority: UNCLASSIFIED	
3. Declassification/Downgrading Schedule:	
4. Distribution/Availability of Report: DISTRIBUTION STATEMENT A: APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.	
5. Name of Performing Organization: JOINT MILITARY OPERATIONS DEPARTMENT	
6. Office Symbol: Naval Command and Staff College	**7. Address:** NAVAL WAR COLLEGE 686 CUSHING ROAD NEWPORT, RI 02841-1207
8. Title (Include Security Classification): Operational Meteorology and Oceanography (METOC) ~~Support~~ and Network-Centric Warfare: Implications for the Joint Force Commander (U)	
9. Personal Authors: Lieutenant Commander Robert S. Steadley, U.S. Navy	
10. Type of Report: FINAL	**11. Date of Report:** 13 Feb 98
12. Page Count: 27	
13. Supplementary Notation: A paper submitted to the Faculty of the NWC in partial satisfaction of the requirements of the JMO Department. The contents of this paper reflect my own personal views and are not necessarily endorsed by the NWC or the Department of the Navy.	
14. Ten key words that relate to your paper: Network-Centric Warfare, Net-centric, Joint METOC, JTF Provide Promise, Joint Operations, JMFU, Copernicus, NEMOC, JTCB	

15. Abstract: After a number of years of exponential growth in the technologies of computing power and global wireless communications, the U.S. Navy has adopted Network Centric Warfare (NCW) as the latest "Revolution in Military Affairs". This concept has the potential for wide application in the joint arena, where the rapid rate of data and information assimilation, fusion, and dissemination offer the Joint Force Commander (JFC) the *potential* to achieve Dominant Battlespace Awareness.

Adapting to a "network-centric" environment should be a key focus of all DOD components, but particularly service organizations, such as meteorology and oceanography (METOC), who will be tasked to support an ambitious charter of network requirements. The components must therefore scrutinize current operations with an eye towards supporting the concept of network *nodes*, which would act as a control and fusion hubs for the vast amounts of data and information flowing into the network. These *nodes* would serve as focal points for the flow of *full spectrum* support across the range of warfighters operating in a particular Joint Operating Area (JOA).

When applied to the joint arena, the JFC, through the assigned Joint METOC Officer (JMO) should assess the best location and composition of the supporting *node*, with respect to the nature of the assigned mission and JOA. This paper discusses a number of METOC *node* options available to the JFC.

16. Distribution / Availability of Abstract:	**Unclassified**	**Same As Rpt**	**DTIC Users**
	X		

17. Abstract Security Classification: UNCLASSIFIED	
18. Name of Responsible Individual: CHAIRMAN, JOINT MILITARY OPERATIONS DEPARTMENT	
19. Telephone: 841-6461	**20. Office Symbol:** C

Security Classification of This Page Unclassified

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After a number of years of exponential growth in the technologies of computing power and global wireless communications, the U.S. Navy has adopted Network Centric Warfare (NCW) as the latest "Revolution in Military Affairs". This concept has the potential for wide application in the joint arena, where the rapid rate of data and information assimilation, fusion, and dissemination offer the Joint Force Commander (JFC) the *potential* to achieve Dominant Battlespace Awareness.

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Within the joint arena, the JFC, through the assigned Joint METOC Officer (JMO) should assess the best location and composition of the supporting node, with respect to the nature of the assigned mission and JOA. This paper discusses a number of METOC node options available to the JFC.

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INTRODUCTION

After a number of years of exponential growth in computing power and "connectivity", the U.S. Navy has acclaimed "network-centric warfare" (NCW) as the latest Revolution in Military Affairs (RMA)[1]. With the power and flexibility of the network come requisite organizational challenges. Perhaps the most crucial challenge facing those providing combat service support is that of designing network nodes or hubs that are capable of translating the vast amounts of data and information resident within a global network into pertinent and concise information on the theater and operating level for the supported CINC and Joint Force Commander (JFC). While keeping pace with these technological trends, the meteorology and oceanography (METOC) community, both Air Force and Navy[i], must also conform their current operational thinking towards that which will best support the demanding requirements of the CINC and JFC through NCW. Likewise, it is the responsibility of the CINC and JFC to understand the capabilities and limitations of "virtual" warfighting support, and therefore determine where the hub or node of support should physically reside within the structure of their supporting component commands. This node should be the central point from which all *definitive* METOC information flows, providing a common focus for joint force planning and execution within a particular Joint Operating Area (JOA). The resulting architecture should be sufficiently robust and flexible in order to accommodate any combination of Joint and Combined Force operations occurring simultaneously in a JOA.

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[i] The U.S. Air Force and Navy operate centralized forecast centers and regional (operationally focused) METOC centers which serve as the focal point of all operational level METOC support to the U.S. armed forces components. Operationally, the USAF provides the bulk of the Army's METOC support, while the U.S. Navy provides support to the Marine Corps.

The purpose of this paper is twofold: first, to propose several avenues of change on the part of component METOC communities in order to facilitate a transition to a Network-Centric Warfare environment; and second, to explore the range of options available to the JFC in designating an environmental support node within the network as well as its physical location.

The method of approaching these issues is to first define and discuss the concept of NCW as proposed by Vice Admiral Arthur Cebrowski, USN, Space Information Warfare, Command and Control (N6)[ii]. Next, this paper will briefly illustrate the limitations of current "platform-centric" METOC operations in the case of recent U.S., NATO, and U.N. operations in the Former Yugoslavia (Bosnia). Next, NCW concepts will be applied to Bosnia operations to show how the components must re-focus their operational thinking in relation to the JFC. Finally, there will be a discussion of the range of issues facing the JFC with respect to designating an environmental support node. Among these options are CONUS-based rear-echelon support, such as the METOC Anchor Desk (MAD) program, regional support, from component-level METOC centers within the theater of operations (TOO), and forward-deployed support, either ashore or afloat, which would be collocated with the JTF staff.

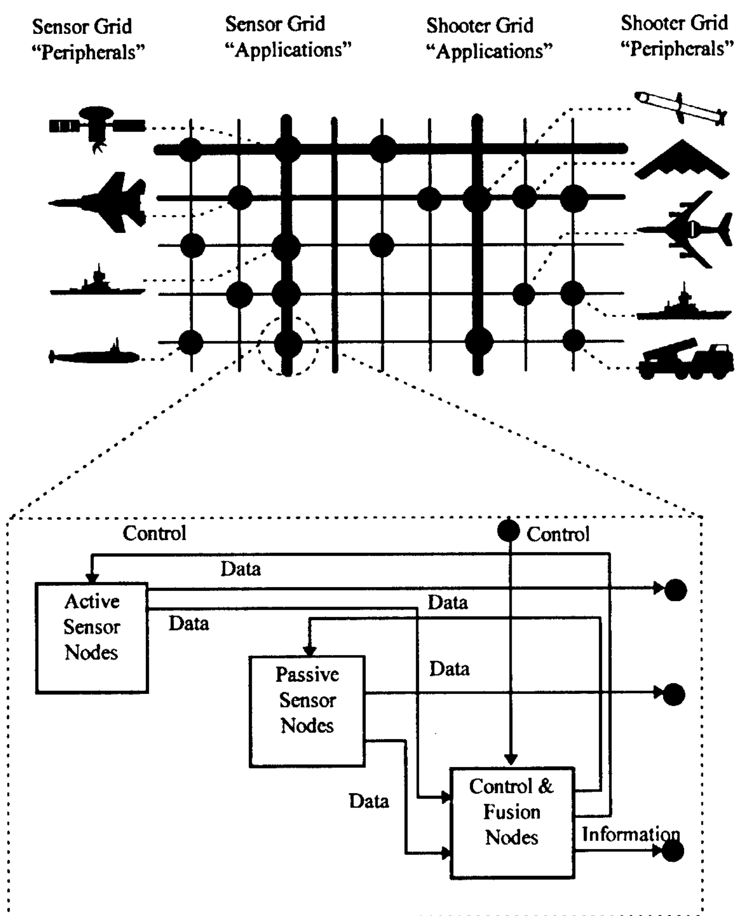
NETWORK-CENTRIC WARFARE

> Network-centric warfare depends on interlocking 'grids' of sensors, command and control, and shooters. The "sensor grid" allows for a dynamic balancing of "pre-planned tasking" with "real-time" re-tasking. Sensors generate the components of [Dominant] Battlespace Awareness [DBA]. The "shooter grid" enables integrated force management and execution of time-critical missions and exploits the battlespace awareness provided by the sensor grid.[2]

[ii] While VADM Cebrowski has led the Navy's NCW charge, his previous tour on the Joint Staff (J6) galvanized joint "buy in" to the concepts outlined in this paper.

Fueling the drive towards NCW are rapidly evolving commercial capabilities in the areas of computing power and "connectivity", or global wireless communications, which allow the assimilation of vast amounts of intelligence and targeting data within a theater to support Dominant Battlespace Awareness (DBA). Network-centric warfare represents a fundamental shift in warfighting from engagements originating from individual weapons platforms, or "platform-centric" warfare, to that of a "netted" system of platforms[3]. A graphical view of the network appears in Figure 1.

Figure 1.



Network-Centric Grid[4]

System Architecture

Within this architecture, an *operational* METOC control and fusion node would assimilate the vast amount of environmental data and information impacting the TOO, coordinate C2 for *all* tactical METOC elements providing support for the JOA, and provide the definitive *full spectrum* operational forecast for the network. As indicated in Figure 1, this METOC node would be subject to the control of the JFC, through the assigned JTF staff Joint METOC Officer (JMO).

Several key features have emerged which will facilitate the JMO's coordination of requirements among the assigned warfighting components. These features include collaborative and communications tools, as well as hypertext applications.[5] Collaborative tools such as a shared whiteboard, would allow the JMO and any number of (geographically separated) component staff METOC officers to annotate imagery and compare notes in real time on a "virtual" blackboard[6]. Hypertext applications, such as an internet web browser, allow decision makers the ability to access a common "virtual" bulletin board supporting the full range of operations within the JOA. These types of hypermedia applications, along with videoteleconferencing (VTC), have been shown to provide a much higher level of cognition (and improved decision making) than traditional methods of shared information (such as autodin message traffic).[7]

Within this framework, speed is the governing factor necessary to achieve the synergistic effects of NCW, with the goal of "locking out" enemy responses and achieving "overwhelming speed of command"[8]. Dominant Battlespace Awareness/Knowledge (DBA/K) plays a key role in the network's speed of command.

Effective DBA/K theoretically provides the JFC with a near-omniscient view of the battlefield, diminishing the "fog", or chaos, of war while employing the joint force network to achieve dominant maneuver, precision engagement, focused logistics, and full-dimensional protection. Critics of this *detail-control*[iii] concept of operational thinking point to the tendency towards a centralized, or flattened, execution hierarchy that places far too much faith in the system's ability to lift "fog" from the battlefield, while ignoring the chaos inherent in the complex system interactions that constitute the network[9]. The purpose of this paper is to take a critical look at the network and analyze ways to at least partially lift this system chaos by streamlining the flow and content of information into the network. While the focus of this paper is operational METOC, the issues apply to other combat service support areas such as logistics and communications.[10]

Joint METOC Forecast Unit

Joint doctrine has already identified the ideal framework for the environmental support node, that of the Joint Meteorology and Oceanography (METOC) Forecast Unit, in Joint Pub 3-59. According to doctrine, the JMFU may be located within or outside the theater, fixed or mobile, and either ashore or afloat, depending on the requirements of the JFC. Regardless of its location, however, the function of the JMFU should be to serve as the primary control and fusion node for all environmental factors affecting the mission of

[iii] A distinction is drawn between two schools of information thought; information and industrial models. The information model emphasizes a centralized *detail-control* mindset that relies on precision, certainty and order. The concept of NCW falls under this model. The industrial model, on the other hand, accepts the chaos inherent in war, relying instead on a de-centralized *mission-control* approach. Maneuver warfare falls under this latter category. This distinction is not raised for debate, but rather to highlight a perceived weakness in the proposed concept.

the JFC within the Joint Operating Area. As the control node, the JMFU tasks in-theater METOC sensors and assets required to support operations within the JOA. In its fusion mode, the JMFU assimilates vast amounts of information within the theater, combining CONUS-based centralized METOC forecast models to provide operational forecasts for the theater. Ideally, the JMFU would facilitate unity of effort and synchronization of combat effects by providing a common view of environmental effects on the battlefield. In practice, however, there is a long way to go, as shown during recent operations in the former Yugoslavia.

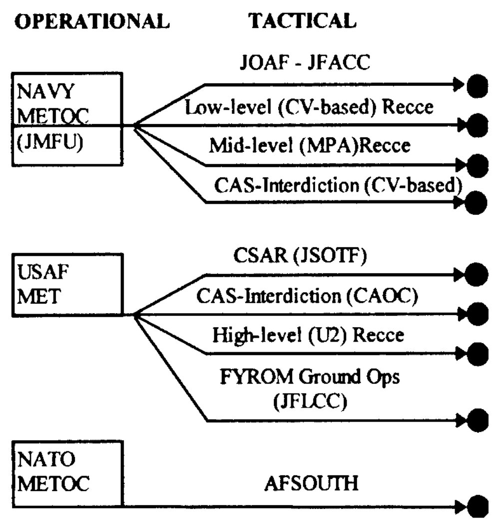
BOSNIA "PLATFORM-CENTRIC" OPERATIONS

From the outset, operations in the former Yugoslavia were characterized by the complexity of entangled command structures operating within the Bosnia area of operations. As a frame of reference, the scope of this paper is limited to the period during which Joint Task Force Provide Promise (JTF-PP) coordinated humanitarian aid for the Former Yugoslavia. During this period (1993-1995), operations centered on Bosnia included Operations DENY FLIGHT (NATO air operations enforcing the "no-fly" zone over Bosnia), SHARP GUARD (NATO maritime operations enforcing UN sanctions on the Bosnian warring parties), and ABLE SENTRY (U.N. ground operations preventing the spread of hostilities into the Former Yugoslavian Republic of Macedonia (FYROM)). In addition to these operations were a number of miscellaneous Interagency (IA) and U.N. Protection Force (UNPROFOR) operations taking place within Bosnia.

METOC Information Flow

In accordance with doctrine set forth in JP 3-59, the JFC designated a JFMU (Naval Oceanographic Command Center - NOCC Rota, SP) to provide METOC support for "air-land" (Sarajevo humanitarian airlift) and "air-drop" (air drop of humanitarian supplies over remote locations) missions into Bosnia. In this role, the JMFU provided the Joint

Figure 2.



Bosnia METOC Support

OPAREA Forecast (JOAF), which was tailored specifically for operational planning of humanitarian missions. While the forecast was disseminated to all operational and tactical units involved in Bosnia, its sole focus was that of mission planning for the Joint Force Air Component Commander (JFACC) who coordinated humanitarian air missions into Bosnia. In its naval component role, NOCC Rota also served as the focal point for operational METOC support to the tactical mission areas shown in Figure 2.

As the European theater Air Force MET component, the European Forecast Unit, located in Traben-Trabach, GE, provided operational support to the mission areas shown in Figure 2. Among these missions were Close Air Support (CAS) and high level reconnaissance, whose missions were critically intertwined with the humanitarian mission of JTF-PP. The third major strand of operational METOC support was that of the NATO MET Center, onboard Allied Forces South (AFSOUTH), Naples, who provided operational briefs to the CINC(SOUTH), who was dual hatted as CJTF-PP.

In summary, operational METOC support for Bosnia filtered through three distinct sources: USN, USAF, and NATO. Complicating the situation was the fact that these three component level organizations prepared forecasts based on a diverse range of forecast models. The Navy relied heavily on centralized forecast models generated by Fleet Numerical Oceanography Center (FNOC), Monterey, CA. The USAF relied heavily on numerical models generated by the German Military Geophysical Office (GMGO).[11] Finally, the AFSOUTH MET Office placed weight on forecast models run by the Italian MET Bureau. The point here is that forecasts based on different models might often differ significantly out to 24 hours, not to mention at the 48 hour and 72 hour marks which serve as the focus of operational planning. The bottom line, from the Joint Force Commander's perspective, was the perception of a discontinuity in the flow of a common METOC thread across the warfighting spectrum, making synchronization of forces difficult. Since there was no "battlefield common operating picture"[12], JTF, NATO, and component commanders planned and executed their missions based on differing expectations of the environment.

Litmus Test: Exclusion Zones

To illustrate why this issue was of critical importance to the JFC, consider a case that occurred during the early stages of NATO direct action missions over Bosnia. The situation involved the enforcement of exclusion zones set up by the U.N. to protect designated "safe" areas in Bosnia. On February 9, 1994, the U.N. passed a resolution calling for the Bosnian Serbs to remove all heavy weapons outside a declared exclusion zone around the city of Sarajevo. During the 10 day period leading up to the date of the ultimatum, however, an extended stretch of foul weather precluded aerial reconnaissance assets from acquiring sufficient imagery of the exclusion area upon which to base conclusive evidence of Serb compliance. During this period, the USS Saratoga flew 15 TARPS (photo imaging) mission sorties over the OPAREA, capturing several thousand images over 20 suspected targets. Of these, only a *single* useable image was obtained due to the extensive cloud cover over the region[13]. Fortunately for the U.N., the weather cleared briefly in the "eleventh hour", one day before the ultimatum deadline, allowing the collection of the imagery necessary to confirm Bosnian Serb compliance with the terms of the ultimatum. Throughout this crisis, forecast precision and agreement across the range of warfighters was increasingly at a premium. Here, the importance of a "common operating picture" over the JOA was necessary to ensure the synchronization of forces, from humanitarian missions to CAS, from reconnaissance to air interdiction, and from JSOTF operations to those of U.N. forces on the ground in FYROM. The planning of each mission area hinged on their respective forecasts, which as could be expected, differed to some extent. As such, the JFC (CINCSOUTH) had to deal with planning inputs from the various components which were based on differing operational (environmental) considerations.

At this stage, it is important to note that while operational forecasts differed, they were not generated in a vacuum. Painstaking efforts were made to share data, information, and imagery among the operational staff support elements in order to reconcile forecast differences. However, despite these efforts, the staff forecasters did not always reach a consensus. Impediments to reaching a consensus on these forecasts were often the lack of interoperable systems to exchange data and imagery among the component and NATO METOC centers, archaic communications (telephone in most cases) available to conference decisions, and quite simply professional differences in opinion that could not be resolved in a timely fashion, given the technological constraints.

These problems of reaching timely and unified forecast consensus are not new. During World War II, a joint METOC staff was set up in the UK to support Operation OVERLORD. This staff was divided into three teams and dispersed to various locations throughout the UK in order to ensure survivability. The lead METOC staff under James M. Stagg would conference daily with the other two teams to scrutinize the various forecasts and provide a consensus to the CINC. According to Stagg, after one such conference on 2 June, he "was expected to present General Eisenhower an 'agreed' forecast for the next five days which covered the time of launching of the greatest military operation ever mounted: no two of the expert participants in the discussion could agree on the likely weather even for the next 24 hours."[14] On the "platform-centric" level, improved technology has certainly increased the rate at which environmental data is collected and analyzed, however it may have done nothing more that accelerate the time it takes for forecasters to disagree.

BOSNIA REVISITED: A NETWORK-CENTRIC VIEW

While professional disagreements over a common operational forecast will continue to exist, "network-centric" collaboration promises to allow the JMFU, JMO, and components the ability to greatly accelerate the consensus rate, while providing a quantum leap in accuracy. While the effect of a NCW system will be to flatten hierarchy and put the operational decision makers in parallel with joint and combined sensors and shooters, the supporting components should maximize the use of these network tools and applications in order to eliminate information discontinuities across the networked platforms. Speed and unity of effort are paramount to the JFC. In fact, during some of the most intense periods of action surrounding NATO's enforcement of exclusion zones around Sarajevo, the CAS/ Interdiction system set up under the U.N./NATO agreement was reportedly designed to react so quickly that the CINC(SOUTH) might not be aware that a mission was underway until it had already commenced[15] Within a network-centric system, the JFC (and supported CINC) should have the ability to obtain, through one query to the METOC node, a definitive set of forecast parameters impacting operations in the JOA. Joint forces linked to a common hypertext bulletin board, could be assured that the JFC and CINC were aware of their respective planning and execution considerations. In Bosnia, the case involving exclusion zones could have been approached in the following manner.

Scenario

Within 36 hours of the ultimatum calling for the removal of heavy weapons around Sarajevo, the JMO is tasked to provide the JFC with a number of METOC forecasts impacting the assigned component forces. First and foremost, the JFC must know how the weather will impact the "air bridge" from the JFACC based in Vicenza, Italy to Sarajevo over the next three days. Second, the JFC requires a precise operational reconnissance forecast out to 36 hours in order to synchronize platform employment through the Joint Targetting and Coordination Board (JTCB). Operational considerations include the deployment of high level reconnissance platforms from the UK, mid-level platforms from Sicily, and low level assets operating from aircraft carriers in the Adriatic. Next, from a standpoint of force protection, the JFC requires forecasts for CAS and Interdiction aircraft operating out of Vicenza, Italy. Finally, due to the potential for Serbian backlash into FYROM, the JFC requires ground force combat weather conditions impacting U.N. bases on the border of Serbia and FYROM.

METOC Coordination

Having received CJTF-PP/CINCSOUTH guidance to provide full spectrum support to the JOA, the JMFU proceeds to set up a hypertext bulletin board with forecast categories covering the above requirements. The JMO uses the network whiteboard tools to coordinate operational support requirements with METOC staff supporting the "netted" forces, to include (1) U.S. Air Forces Europe (USAFE) METOC units supporting USAF reconnissance platforms; (2) U.S. Naval Forces Europe (USNAVEUR) METOC units supporting carrier based CAS/Interdiction assets and shore-based reconnissance platforms; (3) the assigned JFACC and CAOC MET staffs supporting the "air bridge" and shore based NATO CAS/Interdiction aircraft; and (4) USAFE units supporting the JFLCC based in FYROM. Once these requirements have been established, the JMO passes them to the JMFU via the network. The JMFU then coordinates theater METOC assets and sensors necessary to support these requirements. Finally, the JMFU posts corresponding forecasts on the hypertext bulletin board which serves as the node*'s* distribution point for the network. From this point forward, throughout the planning cycle, all organizational tiers[iv] access a set of *common* METOC forecast parameters which has been prepared based on a *common* set of forecast models by a team of joint METOC experts. Meanwhile, robust network capabilities would ensure that forecasts were available in near-real time to the operational user, particularly the JTF staff, in order to keep up with the demanding requirements of operational planning cells such as the JTCB.

Above all, in order to effectively synchronize the employment of networked forces to achieve the massing of combat power effects, the JFC must ensure that from the stage of "pre-planned tasking" to that of "real-time" re-tasking[16] these forces operate on a common view of the battlefield. Designating the JMFU as the hub of full spectrum METOC support for a given JOA would ensure that this occurs.

NODE LOCATION AND COMPOSITION

Given the requirement for centralized METOC support to the network, the next issue is to designate the composition and location of this METOC node.

[iv] Organizational tiers include the theater CINC at the theater-strategic level, the JFC at the operational level, and the functional or service components at the tactical level.

Regional METOC Center

The first alternative, as illustrated in the case of Bosnia, is that of the regional METOC center (RMC). These RMCs maintain a high level of regional expertise while offering the JFC a pre-existing support infrastructure that facilitates early efforts to shape the battlefield. Second, RMCs maintain state of the art automated data processing (ADP) networks and robust, redundant communications capabilities that are much more capable of providing fusion and control node functions than those of most ad-hoc JTF's deployed to remote locations either ashore or afloat. Despite the advances in shipboard technology, wireless communications continue to prove the Achilles heel of afloat units. The control and fusion functions of a network node, or in this case the JMFU, demands a robust and reliable communications path to regional, theater, and global assets. The one disadvantage of maintaining the JMFU at a regional center, vice collocated with the JFC, is that of a lack of direct face-to-face contact with the JTF staff. Lessons learned during Exercise TANDEM THRUST '92 indicated that the assigned JMFU located remotely at a RMC ashore in Hawaii was unable to effectively coordinate and provide timely operational forecasts for warfighting missions, including strike and ASW due to limited communications capabilities. As a result, the JMFU was excluded from vital support to the JTCB (a function which required additional staff augmentation onboard the flagship)[17] Here, as in the case of Bosnia, the JMFU was relegated to providing limited "broad strokes" environmental forecasts for the JOA because of the lack of timely information exchange between the JTF staff and the JMFU. However, with the advertised capabilities of the Global Broadcast System (GBS), including bandwidth on demand and Video Teleconferencing (VTC), the RMC will be able to effectively coordinate warfare requirements with the JMO and provide support in near-real time, allowing sufficient lead time for the JTCB cycle.

METOC Anchor Desk

In addition to the regional METOC center (RMC), are two other alternatives currently under review. The first is that of a rear-echelon centralized support site, known as the METOC Anchor Desk (MAD), currently undergoing operational evaluation by CINCPACFLT under the Department of Defense Advanced Research Projects Agency (ARPA) contract. This program is a subset of the larger JTF Reference Architecture (JTF RA) program, whose goal is to optimize the NCW architecture with respect to the Joint Force Commander's Estimate of the Situation (CES) process[18]. Under this concept of operations (CONOPS), the CONUS-based MAD would be arrayed to regional, theater, and global assets, and serve as the node of operational METOC information for the JFC. The aim of the MAD program is that of a more centralized support structure, decreasing "tail-to-tooth" ratio overseas in light of the prospect of reduced overseas force structures. Another advantage of the CONUS-based MAD would be the close proximity to national assets, should they be required in support of the operation. The principle drawback, related to its rear-echelon proximity, is that the centralized control and fusion site is too far removed from the battlefield. Regardless of the capabilities advertised by VTC, there will always be a clear advantage gained by "being there" (in the Theater) to support the forces deployed to the theater.

Forward Deployed Joint METOC Forecast Unit

The last option would be that of a forward-deployed node, or JMFU staff, collocated with the JTF staff either afloat or ashore, depending on the nature of the crisis. This option is perhaps the least desirable of the three alternatives when dealing with an afloat-based staff, due to the high "tail-to-tooth" ratio imposed by an embarked staff. The main advantage of a forward deployed JMFU is that of direct face-to-face contact with the JFC and staff, which speeds the flow of critical METOC information to the planning process. However, despite the robust communications capabilities advertised under GBS, the high bandwidth demands of an afloat JMFU (required for control and fusion functions) would be highly prohibitive. Another disadvantage of an afloat JMFU staff is that of the ad-hoc nature of the staff organization when compared to the RMC. Regional centers maintain a high level of forecast expertise in-theater earned by sustained interaction and feedback with their supported theater forces and organizations. Ad hoc JMFU staffs would require a considerable amount of time and effort in order to get up to speed on theater operations, as well as network with supporting theater assets and organizations. This puts the deployed JMFU at a disadvantage in the early stages of an operation, when time is of the essence.

CONCLUSIONS AND RECOMMENDATIONS

As the concept of Network Centric Warfare begins to coalesce into joint doctrine and drive Joint Force Requirements (JFRs), the service components must begin to think in terms of streamlining and tailoring current operations into those that will most efficiently support the network. As pointed out by critics of this detail-control concept of operational thinking, the major roadblock to achieving unity of effort and combat synergy is overcoming self-inflicted fog, or chaos, of complex network interactions. The goal therefore should be to minimize the number of inputs into the network by streamlining information before it arrives at the network node. The following recommendations are made in order to move towards this goal:

1. Full Spectrum JMFU Exercise Support. The NCW architecture charted in Figure 1 will leave no room for individual METOC component competition in providing mutually exclusive METOC information to a common JOA. From a synchronization standpoint, a "network-centric" system (not to mention the JFC) will simply not tolerate a diverse range of forecasts which jeopardize network integrity and unity of effort. As such, RMCs must begin to shift their focal point from supporting service specific operations and exercises to that of *full spectrum* METOC support to the JFC and assigned forces.

2. Trend Towards Joint RMCs. During JTF-PP there was a small degree of personnel exchange between the component RMCs (USAF personnel assigned TAD to the JMFU) to support the limited scope of the mission functions. However, if the RMCs are tasked in the future to act as NCW nodes, providing full spectrum support, the components must take a hard look at the adequacy of maintaining separate theater component RMCs. There is a strong case to be made for a merger of these centers into a Joint RMC (JRMC), that would more readily assume the mission of providing full spectrum support. Joint Typhoon Warning Center, Guam is a prime example of successful component-level integration within the Pacific theater. This template should be applied to other theaters such as CENTCOM and EUCOM. While the prospect of these JRMCs may be unlikely in the very near future, the opportunity and charter for a much more aggressive USN/USAF METOC cross training program has never been more compelling.

3. Maintain the RMC as the 911 METOC Node. There may be some cases in which the alternatives to a RMC, that of rear echelon (CONUS-based) support or forward deployed JMFU's, may be better suited to the JFC's crisis response scenario. However, RMC's continue to maintain the ideal framework and theater focus required to serve as the NCW node in the bulk of crisis response scenarios. These centers should remain as the JFC's first choice for worldwide crisis response METOC support.

In conclusion, there is no doubt that the proposed architecture will prohibit the status quo. It will, by necessity, drive the components toward new heights of jointness. Those organizations clinging to traditional service component missions and function will ultimately find themselves locked out of the network, and as such without a mission on the battlefield of tomorrow.

NOTES

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[17] "Theater METOC Forecast for Joint Task Force Exercises or Operations" JULLS no. 81825-75400. 24 July 1992. Joint Uniform Lessons Learned (JULLS) Database. (Washington: December 1997).

[18] "The JTF ATD Anchor Desk Concept." METOC Anchor Desk Public Page, <http://mako.evol.ri.cmu.edu/wxad/> (31 Jan 98).

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